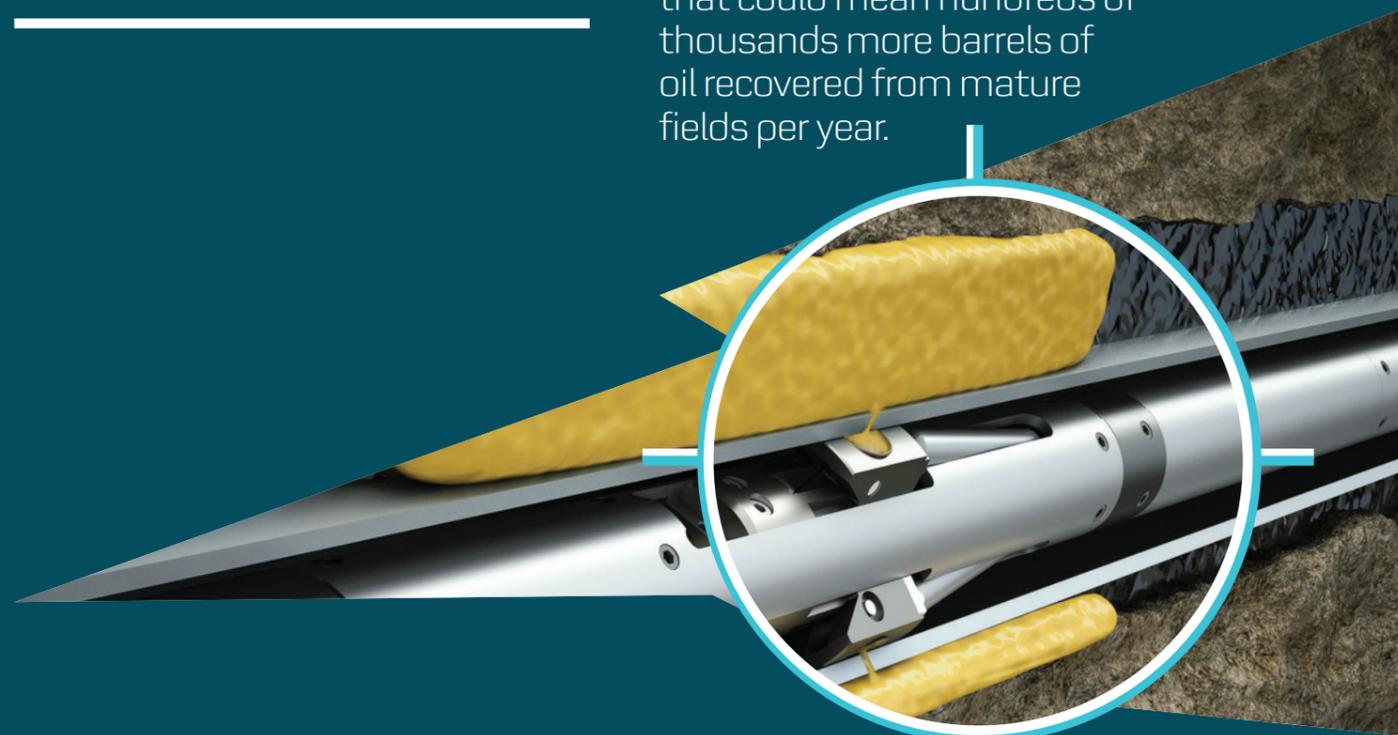


SEALING THE CRACKS IN MATURE FIELDS



by Michael Pitts

By taking a chance on new technology and a startup company, Maersk Oil has achieved a groundbreaking repair method that could mean hundreds of thousands more barrels of oil recovered from mature fields per year.



Potential

+10-20%
Recovery per well pair

~200,000
barrels per year at cost of 10 USD/boe² (across Halfdan/Dan)

30
Conformance opportunities identified

For a number of years the Conformance team in Maersk Oil's Danish Business Unit (DBU) has been working alongside a small start-up company called CannSeal to develop a method of placing a sealant in the annulus which is uncemented. Now the collaboration is beginning to bear fruit – and it could mean hundreds of thousands more barrels of oil produced in mature fields.

The problem occurs when a fracture opens up between a water injection well and a neighbouring producing well. Water injection relies on generating high pressure that sweeps oil out of the reservoir. If there's a connection, oil is bypassed and production falls. Finding a way to plug the fracture connections is therefore increasingly important in ageing fields.

A PIONEERING OPERATION

In October 2015 the Conformance team, along with WellServices, tackled the fractures that had occurred in an injector well called HDA-33. HDA-33 is a CAJ (Controlled Acid Jetting) completed water injection well in the south side of Halfdan field. When a neighbouring producer well, HDA-31, was being initially stimulated a fracture occurred causing a direct connection to HDA-33. Immediately HDA-33's injection became less effective and surrounding wells lost pressure support and sweep.

To repair the problem, a chemical sealant (resin) needed to be squeezed into the space around HDA-33 – the annulus. However, CAJ wells lack annular isolation, presenting a problem of how to direct the resin into the right place. A retrofitted solution was needed.

First, the Conformance team and WellServices placed three annular (donut) type plugs in the HDA-33 injector well. Then they placed a type of resin between the plugs to seal the fracture. This operation achieved two world firsts: the use of the CannSeal tool to place the annular plugs, and the pumping of ThermaSet resin through coiled tubing into the space between the plugs.

HOW THE CANNSEAL TOOL WAS USED

The CannSeal tool brings epoxy down the well in sealed canisters, perforates the well liner, orientates injection pads around the perforations, and then squeezes epoxy behind the liner. The epoxy forms a plug (or donut) in the annulus behind the liner, thereby providing annular isolation.

THE RESULTS

In September 2016, coiled tubing was deployed back into HDA-33 to complete the removal of the straddle and the well was put back into operation. Before the repair, within an hour of injection in HDA-33, a response would show in HDA-31. Now, HDA-33 has been injecting at 6000bopd (its target injection rate) since mid-October and there has been no response in HDA-31.

This successful repair opens up the possibility of unlocking millions of barrels in lost reserves suffering from similar connections and fractures.

The project has been the culmination of years of work by the Conformance team, headed by the Project Manager Yuting Leong. It is this faith in new technology and taking the chance with start-up companies that allows Maersk to stay ahead of the competition. ■

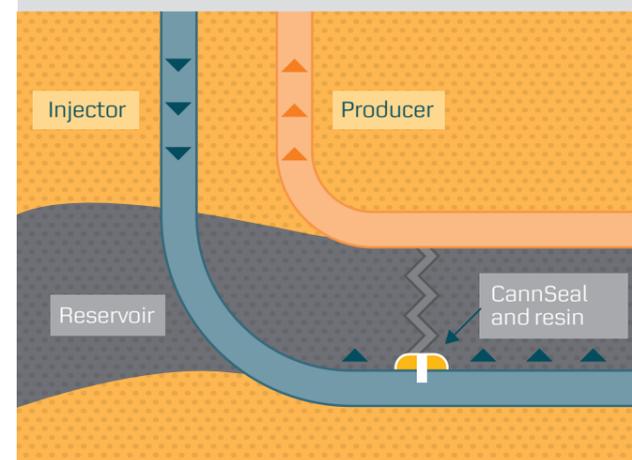
Differentiating technical capabilities leveraged to increase production in mature field

Challenge

- Water injection applied in mature Dan and Halfdan fields
- Reservoir fracture connection makes water injection less effective

Approach

- Fracture identified using 4D (time lapse) seismic
- CannSeal deployed to re-establish conformance control



At a glance

Purpose:
Unlocking by-passed oil

Technology:
Injected resins and annular isolation

Impact:
Increasing recovery by millions of bbls

Completion date: 2019